DEVELOPMENT OF SPICY BUTTER ENRICHED WITH BLACK SESAME SEEDS

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The demand for spiced dairy products, such as spicy butter and cheese, has been rising recently on the international market. This research aimed to develop a novel spicy butter enriched with black sesame. The spicy mixture consisting of garlic (*Allium sativum* L.), white pepper (*Piper nigrum* L.), and ginger *(Zingiber officinale* L.) powder in a ratio of (3:2:1) was used as a base mixture. The spicy mixture consisting of garlic (*Allium sativum* L.), white pepper (*Piper nigrum* L.), and ginger *(Zingiber officinale* L.) powder in a ratio of (3:2:1) was used as a base mixture. In addition, 2% black sesame (*Sesamum indicum* L.) was added to improve the nutrition and flavour. Sensory attributes such as appearance, colour, taste aroma, texture, spread ability, spiciness, aftertaste, mouthfeel, and overall acceptability were analyzed using 30 untrained panellists. The best-selected spicy butter sample was examined for proximate analysis, microbiological counts, free fatty acids (FFA), peroxide value (PV), and composition at two-week intervals for the final product during the 12-week storage period at 4^0C conditions. 6% spices, 2% black sesame, and 2% salted butter showed significantly higher scores, aroma, mouthfeel, and overall acceptance compared to the other tested parameters. According to proximate analysis, the fat moisture, and ash content of spicy butter were 82.25±0.35%, 11.55±0.01%, and 1.62±0.01%, respectively. Spicy butter had a significant reduction ($p<0.05$) in the free fatty acid content of 0.38±0.00 compared to the control during the storage at 12 weeks. There were significant decreases ($p<0.05$) in peroxide values compared to the control samples 0.23±0.01, 0.58±0.00, 0.79±0.00, 1.07±0.01, and 1.47±0.00, respectively. This reflects the effect of spice on the reduction of free fatty acids and peroxides, leading to control of the rancidity of butter. Similarly, spicy butter showed a significant reduction in peroxide value. Spicy butter showed a significant increase in microbiological counts over the storage period. However, the counts were less and within the standards up to 12 weeks of storage period. Spices could be used to create preservative action, reduce rancidity, and extend the shelf life of the developed sesame-enriched spicy butter.

Keywords: Butter, Natural Preservatives, Sesame, Shelf life, Spice

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INTRODUCTION

Milk is a nutritious food product consumed heavily by people in different forms (Çetinkaya, 2021). Butter is one of the oldest dairy products in the world, prepared by churning fresh or fermented milk or cream (Goff, Hill, and Ferrer; Silva et al., 2022). Butter is one of the ancient methods of conserving milk fat by extending shelf life. In addition to baking, cooking, sauce preparation, and pan frying, butter is typically used as a spread and condiment (Wimalawardhana, 2007). Butter can be prepared from the milk of various mammals, such as sheep, goats, buffalo camels, and yaks, although it is most made from cow milk (Alganesh and Yetenayet, 2017). Bovine milk is currently the most common source used to produce butter (Deosarkar et al., 2016). Butter is a water-in-oil emulsion (Hae-Soo et al., 2013) containing a minimum of 80% (w/w) butterfat, a maximum of 16% (w/w) water, and a maximum of 2% (w/w) solid-non-fat (Codex Alimentarius). Milk fat contains essential fatty acids needed in the human diet. Lipid-soluble vitamins such as retinol, carotenoids, and tocopherols are important antioxidants for human health (Mendez-Cid, et al., 2017). Butter has an average shelf life of only 109 days when stored at 25-35℃ (room temperature) (Park et al., 2014), and when stored at refrigerated temperatures, is around one year. The main problem affecting butter during storage is rancidification. The process is caused by lipolysis and oxidation of fatty acids, which impairs the flavour and lowers the nutritional quality of butter (Munasinghe et al., 2022). Therefore, there is a need to find a suitable additive to prevent rancidity and extend the shelf life of the butter. Today, spices and herbs are added to meals worldwide to increase shelf life and enhance the organoleptic qualities of the dish. Spices and herbs are helpful in dairy products as a flavour fixative because of their antibacterial and antioxidant qualities (Vidanagamage et al, 2016). Adding herbal spices to butter can prevent rancidification. Garlic (*Allium sativum* L.) is well known for its fibrinolytic function in lowering blood cholesterol, and it was first identified as a treatment for digestive problems (Sachan et al, 2018). White pepper (*Piper nigrum* L.), constituents are abundant in alkaloids, oleoresins, and aromatic oils. The active component of white pepper,

piperine (1-piperoyl piperidine), has a variety of biological actions, including anti-inflammatory, antioxidant, antimutagenic, and anticancer properties (Liang, et al., 2014). Ginger *(Zingiber officinale* L.) has gingerol, paradol, shogaols, and zingerone in antimicrobial properties (Park et al., 2014). Black sesame seeds (*Sesamum indicum* L.) offer numerous health benefits, including antioxidant, anti-inflammatory, anti-tumour, anti-cancer, and anti-ageing properties (Joung et al., 2017). This study aimed to formulate spicy butter and evaluate the sensory, proximate, physiochemical, and microbiological properties of butter.

Methodology

Butter Preparation

Cow milk was separated into cream and skim milk using a separator. Then the cream was churned until the fat globules coagulate and form a monolithic mass. This butter mass was washed and, 2% of salt was added to improve keeping qualities. The 2% of salted butter was considered as a control (T1). Treatment (T2) used a spicy mixture (3% garlic, 2% pepper, and 1% ginger) identified by the pretrial. Treatment (T3) added different percentages of sesame seeds: 1%, 2%, 3%, and 4% with selected spicy butter. Samples were stored in the refrigerator at a temperature of 4 °C and analyzed every other week for three months.

Table 1: Selection of the best level of spicy mixture with butter.

Treatments (T3)	Control 201	Sample 413	Sample 576	Sample 625	Sample 709
Spices ratio (GL:3, PP:2, GG:1)	0%	6%	6%	6%	6%
Black sesame seeds	0%	1%	2%	3%	4%
(2%) Salted butter	100%	93%	92%	91%	90%

Sensory evaluation

A sensory evaluation was performed by 30 untrained panellists from the Open University of Nawala and Milco (Pvt) Ltd. The panellists were aged 18-55 and were "consumers" of commercial milk products. They were given butter samples and bread, and their mouths were rinsed with distilled water after each taste. The five-point hedonic scale was used to evaluate each attribute. The hedonic scale was as follows: 5 = like very much, 4 = like moderately, 3 = neither like nor dislike, 2 = dislike moderately, and 1 = dislike very much.

Table 2: Selection of the best level of black sesame percentage with spicy butter.

Treatments (T2)	Control 201	Sample 412	Sample 575	Sample 624	Sample 708
Garlic (GL)	0%	2%	3%	3%	2%
Pepper (PP)	0%	2%	2.5%	2%	2%
Ginger (GG)	0%	1%	1%	1%	2%
Salted Butter (2%)	100%	95%	93.5%	95%	94%

Proximate analysis

The fat, moisture, total solids, and dietary fibre (ash), content was determined according to the AOAC, 2000 methods.

Physiochemical Properties analysis

Free fatty acids and peroxide values were determined according to the AOAC official method.

Shelf-life analysis

Microbial analysis was determined by (Erkaya et al., 2015) the Total Plate Count (TPC) and Yeast and Mold Count (YMC).

Data analysis

Three replicates were used for each treatment and analyzed using the ANOVA general linear model, using the MINITAB 21 software package. Means were compared with Tukey's multiple comparisons. Sensory data were analysed using one-way ANOVA and the Friedman test.

RESULTS AND DISCUSSION

Table 3: Selection of the best level of black sesame percentage with selected spicy butter.

Attributes (T3)	Appearance	Color	Taste	Texture	Spiciness	Aroma	Spreadability	Mouth feel	After taste	Overall Acceptability
Sample 413	4.86^{a}	4.67^{a}	4.20^{b}	4.50^{a}	4.47^{a}	4.37^{a}	5.00^{a}	4.17^{b}	4.13^{b}	4.29^{b}
Sample 576	4.93^{a}	4.83^{a}	4.78^{a}	4.53^{a}	4.67^{a}	4.53^{a}	5.00^{a}	4.57^{a}	4.53^{a}	4.60^{a}

Sample 625	3.60[b]	3.67[b]	3.33[b]	3.53[b]	3.53[b]	3.77[b]	4.73[a]	3.33[b]	3.30[b]	3.53[b]
Sample 709	3.67[b]	3.57[b]	3.43[b]	3.10[c]	3.53[b]	3.57[b]	3.53[b]	3.23[b]	3.13[b]	3.17[b]

Means with similar superscript letters in a column are not significantly different (P< 0.05)

The selection of the best level of black sesame seed percentage is shown in Table 3. The four samples 413, 576, 625, and 709 prepared for the sensory test. The sensory parameters of appearance, color, texture, taste, mouthfeel, spiciness, spreadability, aroma, aftertaste, and overall acceptability were shown to be significantly different among treatments. The highest overall acceptability observed in sample 576 which contains 3% garlic, 2% pepper, 1% ginger, and 2% black sesame seeds added to butter. There were no significant differences between the 413 and 576 samples in the parameters of appearance, color, texture, spiciness, spreadability, and aroma.

Table 4: Selection of the final product.

Attributes	Appearance	Color	Taste	Texture	Spiciness	Aroma	Spreadability	Mouth feel	After taste	Overall Acceptability
Sample 201	3.93[b]	3.93[b]	2.50[c]	3.37[c]	1.23[c]	1.93[c]	4.13[b]	3.40[c]	2.50[b]	3.43[c]
Sample 624	4.33[ab]	4.37[ab]	4.17[b]	4.33[a]	4.13[b]	4.23[b]	4.93[a]	4.30[b]	4.77[a]	4.23[b]
Sample 576	4.57[a]	4.43[a]	4.83[a]	4.46[a]	4.77[a]	4.77[a]	4.93[a]	4.50[a]	4.83[a]	4.60[a]

Means with similar superscript letters in a column are not significantly different (P< 0.05)

As shown in Table 4, sensory evaluation conducted to select the final product. Sample 201 (control), sample 624 (6% spicy mix incorporated butter), and sample 576 (6% spicy mix and 2% black sesame seeds incorporated butter) were evaluated. Sample 576 showed the significantly highest scores for taste, spiciness, aroma, mouthfeel and overall acceptability compared to other samples.

Table 5: Proximate analysis.

Component	**Control 201**	**Spicy butter 576**

Fat %	84.50±0.70%	82.25±0.35%
Moisture %	14.50±0.07%	11.55±0.01%
Total Solids %	85.49±0.07%	88.45±0.01%
Ash %	1.04±0.02%	1.62±0.01%

Values are means of three replicates ± standard deviation.

The proximate components of butter made from cow milk with spice mix (garlic, pepper, and ginger) and 2% black sesame are indicated in Table 5. There were differences observed in the nutritional properties of the butter. A higher amount of moisture content (14.50±0.07%) was observed in the control; this indicates that spicy butter was a higher source of total solids (88.45±0.01%) compared to the control. However, the percentage of fat in the spicy butter product was within the recommended range of fat content in butter, which should be a minimum of 80% according to the SLSI 279:1988.

Table 6: Free fatty acids values of butter samples during storage.

Treatments	**0 week**	**2 weeks**	**4 weeks**	**8 weeks**	**12 weeks**
control	0.35 ± 0.00^{dx}	0.35 ± 0.00^{dx}	0.39 ± 0.00^{cx}	0.43 ± 0.00^{bx}	0.47 ± 0.00^{ax}
Spicy butter	0.18 ± 0.00^{ey}	0.25 ± 0.00^{dy}	0.29 ± 0.00^{cy}	0.33 ± 0.00^{by}	0.38 ± 0.00^{ay}

Mean with the same letters in column and row are not significantly different at ($p < 0.05$).

Free fatty acid values of analysed data are shown in Table 6. Physiochemical properties such as free fatty acids (FFA) were determined ($p< 0.05$). In addition, a higher free fatty acid content (0.47±0.00) % was observed in the control and a lower (0.38±0.00) % in the spicy butter. There were significant differences observed in the free fatty acids values of butter samples during storage period. Therefore, it was clear that the addition of a spice mixture resulted in a lower percentage of free fatty acids in butter during the storage time. Munasinghe et al. (2022) reported that the free fatty acids (FFA) content was significantly higher in normal butter than in spicy butter.

Table 7: Peroxide values of butter samples during storage.

Treatments	0 week	2 weeks	4 weeks	8 weeks	12 weeks
Control	0.93 ± 0.00^{ex}	1.17 ± 0.00^{dx}	1.47 ± 0.00^{cx}	1.74 ± 0.00^{bx}	2.46 ± 0.00^{ax}
Spicy butter	0.23 ± 0.01^{ey}	0.58 ± 0.00^{dy}	0.79 ± 0.00^{cy}	1.07 ± 0.01^{by}	1.47 ± 0.00^{ay}

Mean with the same letters in the column and row are not significantly different at ($p < 0.05$).

Peroxide values of analysed data are shown in Table 7. The initial peroxide value of normal salted butter (control) was (0.93±0.00) mEq/kg and increased up to (2.46±0.00) mEq/kg after the 12-week period. Similarly, the initial peroxide value of spicy butter, which was (0.23±0.01) mEq/kg, increased to (1.47±0.00) mEq/kg after the 12 weeks period. There were significant differences observed in the peroxide values of butter samples during storage. Oxidative rancidity of butter fat could be the reason for the continuous increase in peroxide value. Spicy butter shows a lower peroxide value compared to the control. Therefore, it was clear that the addition of the spice mixture resulted in a lower peroxide value in butter and during the storage time. This could be due to the natural antioxidants contained in spices, which showed a preservative action on butter. Peroxide value (PV) was used to evaluate butter quality (Krause, et al., 2007). Peroxide values of fresh butter are less than 0.3%; a rancid taste is noticeable when the peroxide value is between 30 and 40 mill equivalents/kg (Wikipedia). Peroxide values of both the spicy butter and normal salted butter (control) have been continuously increased with the storage period.

Table 8: Total plate count of butter samples during storage.

Treatments	0 week	2 weeks	4 weeks	8 weeks	12 weeks
	$\mathbf{Log_{10}}$ **cfu/g**	$\mathbf{Log_{10}}$ **cfu/g**	$\mathbf{Log_{10}}$ **cfu/g**	$\mathbf{Log_{10}}$ **cfu/g**	$\mathbf{Log_{10}}$ **cfu/g**
Control	2.15 ± 0.07^{dx}	2.95 ± 0.02^{cx}	3.12 ± 0.02^{bx}	3.38 ± 0.01^{ax}	3.47 ± 0.01^{ax}
Spicy	2.07 ± 0.02^{ey}	2.82 ± 0.01^{dy}	3.01 ± 0.01^{cy}	3.20 ± 0.06^{by}	3.30 ± 0.01^{ay}

butter

Mean with the same letters in column and row are not significantly different at ($p < 0.05$).

Total plate count is shown in Table 8. During storage, (mesophilic) bacteria were higher in the control (3.47±0.01) sample and lowest in the spicy butter sample (3.30±0.01). Bule et al., (2022) reported that the total aerobic mesophilic plate count significantly increased during storage.

Table 9: Yeast and mould count of butter samples during storage.

Treatments	**0 week**	**2 weeks**	**4 weeks**	**8 weeks**	**12 weeks**
	Log_{10} cfu/g	**Log_{10} cfu/g**	**Log_{10} cfu/g**	**Log_{10} cfu/g**	**Log_{10} cfu/g**
Control	0.77 ± 0.68^{bx}	1.59 ± 1.11^{abx}	1.84 ± 0.06^{ax}	2.11 ± 0.06^{ax}	3.47 ± 0.01^{ax}
Spicy butter	0.33 ± 0.57^{cy}	1.42 ± 0.10^{by}	1.72 ± 0.12^{aby}	1.96 ± 0.05^{aby}	2.28 ± 0.04^{ay}

Mean with the same letters in the column and row are not significantly different at ($p < 0.05$).

Yeast and mould analysed data are shown in Table 9. A higher amount of yeast and mould counts (YMC) observed in the control (0.77±0.68) and the lowest (0.33±0.57) was obtained from spicy butter. However, the yeast and mould count in the spicy butter product was within the recommended range of YMC in butter, which should be yeasts not more than 50 per g and mould not more than 20 per g according to the SLSI 279:1988.

CONCLUSION

The study suggests that spices could be used to create a preservative action and extend the shelf life in the developed sesame-enriched spicy butter. Sample 576, which contains 3% garlic, 2% white pepper, 1% ginger, and 2% black sesame, received the highest score. Finally, butter incorporating 3% garlic, 2% white pepper, 1% ginger and 2% black sesame was more suitable for consumers.

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